

SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ONTARIO



Sault College

COURSE OUTLINE

COURSE TITLE: PAPER QUALITY

CODE NO. : PPE 166 **SEMESTER:**

PROGRAM: PULP AND PAPERMAKING OPERATIONS

AUTHOR: J. BETHUNE

DATE: APR.2004 **PREVIOUS OUTLINE DATED:** APR 2002

APPROVED:

DEAN

DATE

TOTAL CREDITS: 3

PREREQUISITE(S): NONE

LENGTH OF COURSE:

16 WEEKS

TOTAL CREDIT HOURS: 45

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Course Name

Code No.**I. COURSE DESCRIPTION:**

The philosophy of this course is to provide the student with theory as it relates to paper quality. The course is divided into four main paper testing categories; strength, surface, optical, and permeability. The goal is to provide the student with the knowledge and understanding of tests conducted on a finished paper which are used to monitor paper quality. Process control is tied directly to quality and paper testing. Therefore, the final section will briefly highlight the use of Statistical Process Control in the paper industry. The concept of a "zone control chart" is presented as a statistical tool used in some paper mill applications.

II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:

Upon successful completion of this course, the student will demonstrate the ability to:

1. Understand the fundamentals of paper testing

Elements of the Performance:

- Determine how paper is sampled, how many samples are taken and how many tests are conducted per sample for an actual mill.
- Determine the conditioned environment of an actual mill.
- Determine how tests were conducted prior to modern test instruments.
- List the four main paper properties.
- Name the three key components of paper testing.
- Cite the objective of paper testing.
- Explain the statement, "Testing leads to control through action."
- Explain what was wrong with the old test methods used by papermakers.
- Name the organization that standardizes the test methods used in the Canadian paper industry.
- Explain what standardization did for the paper industry.
- Explain why a poor test is sometimes worse than no test at all
- Define "readability" in terms of testing and explain how it can be implemented.
- Define sensitivity, accuracy and precision in relation to testing.
- Explain the way to get the smallest variation between tests.
- Cite the most obvious way to improve test precision.
- Define random sampling.

Course Name

Code No.

- Explain machine direction, cross direction and Z direction.
- State the standard environment for testing paper in North America.
- Explain why it is important not to touch the area of conditioned paper nor to breathe on it.
- Explain why folding endurance, tear and stretch increase as relative humidity increases.
- Explain why tensile and burst decrease as relative humidity increases.
- Explain what happens to paper static with increasing dryness.
- Define “hygroscopic.”
- Explain whether moisture will be higher or lower if paper is brought to equilibrium by drying it from a higher moisture content compared to one brought to equilibrium from a lower moisture content.

2. Indicate a knowledge of physical and strength properties

Elements of the Performance:

- List the three physical properties of paper that are tested
- List five strength properties of paper that are tested
- Define basis weight with its units in Canada and the US
- Define ream weight
- Explain why strength properties generally increase with basis weight.
- Explain how a computer controlled micro-slice works.
- Define caliper.
- Explain what a nine point sheet means.
- Explain how the caliper of the sheet is controlled.
- Define density and bulk.
- Explain what happens to density and bulk if basis weight remains unchanged but caliper decreases.
- Explain whether stiffer fibres give higher or lower bulk.
- Explain what extensive refining does to density and bulk.
- List the four main variables that influence the strength properties of paper.
- Explain how fibres that are too long can lead to lower strength.
- Explain how refining improves fibre bonding.
- List the two factors upon which the collapsibility of a fibre is dependent.
- Define stiffness index, relative bonded area, jet to wire ratio, and dragging.

Course Name

Code No.

- Explain what dragging does to fibre orientation.
 - Indicate whether tensile, tear, fold and elongation give higher values in the MD or the CD.
 - Define tensile strength.
 - Explain why machine made papers have higher CD stretch
 - Explain what TEA is, how it is measured and what it is used to indicate.
 - Name the single most important factor of sheet formation that affects tensile strength.
 - List the four factors that affect tensile strength
 - Define burst strength and name the instrument used to measure it.
 - Explain the primary function of the burst test.
 - Name the four factors which influence burst strength.
 - Explain how long fibres improve strength.
 - Explain why tear rapidly increases with a small amount of refining but soon reaches a maximum and then decreases if refining is continued.
 - Define fold endurance.
 - Define paper stiffness.
 - Name two factors that affect stiffness.
3. Indicate a knowledge of the surface properties of paper

Elements of the Performance:

- Define paper smoothness and explain how it is measured
 - Name and explain four process steps which could improve smoothness
 - Define softness and explain how it is developed
 - List the three variables which influence softness.
 - Define pick resistance and explain ways to improve pick strength
 - Define abrasion resistance and ways to improve it
 - Explain why smoothness, pick resistance, and abrasion resistance are important for paper grades
4. Show an understanding of the optical properties of paper

Elements of the Performance:

- State the wavelength of visible light
- Name the colour that a piece of glass will appear to be if no light is absorbed by it.

Course Name

Code No.

- Name the colour if it absorbs all light.
- Explain diffused scattering
- List the two reasons for adding colour to paper
- Define colour and name the three colours reflected from a paper's surface that define its colour
- Name the colour and wavelength where opacity is measured.
- Explain why opacity and brightness are easier to measure than colour.
- Explain why blue paper appears blue.
- Explain what you do to avoid dulling when mixing colours.
- Explain hue, brilliance of shade.
- Explain what you do to brighten a shade.
- Explain how a spectrophotometer works
- Explain subtractive mixing
- Explain the problem with colouring paper by the pulp colouring method.
- Define whiteness, brightness, and brightness reversion
- Explain what is wrong with using calcium carbonate as a pigment filler.
- Define opacity, printing opacity, transparency, and gloss
- Explain how to improve opacity.
- Explain how to improve gloss.

5 Demonstrate an understanding of barrier and resistance properties

Elements of the performance:

- Name the four main factors that affect the penetration of fluids into paper.
- Explain pore structure.
- Explain why water resistance is important for offset printing.
- Explain why water resistance is important for coating colour.
- Explain why water resistance is important in the manufacture of folding boxes.
- Explain why water resistance is important writing, bond, ledger and index papers.
- Define contact angle and explain when maximum wetting occurs.
- Define initial wettability, rate of wettability and sizing.
- Define slack sized, hard sized, internal sizing and external sizing.
- Explain what water leaf paper is.

Course Name

Code No.

- Name the two categories or methods of measuring water resistance.
 - Describe the dry indicator test.
 - Describe the water drop absorption test.
 - Describe the Cobb size test.
 - Explain how oil and grease resistant papers are made.
6. Demonstrate a knowledge of statistical process control

Elements of the performance:

- Define SPC and explain its purpose.
- Explain what a zone control chart is.
- Construct a zone control chart and indicate when to initiate action to bring the process under control.
- Continue to plot data on a zone control chart after corrective action was taken.

TOPICS:

III.

1. Fundamentals of Paper Testing
2. Physical and Strength Properties
3. Surface Properties
4. Optical Properties
5. Barrier and Resistance Properties
6. Statistical Process Control

IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

Pevato, Kevin, and Bethune, Jack, "Study Guide for PPE 166, Paper Quality" Sault College of Applied Arts and Technology, Sault Ste. Marie, 2002

 Course Name

 Code No.

V. EVALUATION PROCESS/GRADING SYSTEM:

A final grade in this course will be based on the results of three tests weighted equally.

Test No 1 on Lessons 1 and 2

Test No 2 on Lessons 3 and 4

Test No 3 on Lessons 5 and 6

The following semester grades will be assigned to students in all credit courses:

<u>Grade</u>	<u>Definition</u>	<u>Grade Point Equivalent</u>
A+	90 - 100%	4.00
A	80 - 89%	4.00
B	70 - 79%	3.00
C	60 - 69%	2.00
D	50 -59%	1.00
F (Fail)	49% or below	0.00
CR (Credit)	Credit for diploma requirements has been awarded.	
S	Satisfactory achievement in field/clinical placement or non-graded subject areas.	
X	A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.	
NR	Grade not reported to Registrar's office.	
W	Student has withdrawn from the course without academic penalty.	

Under extreme circumstances, students with a final grade of 45-49% may be permitted to write a supplementary exam for a maximum grade of "D" provided they obtained a minimum grade of 60% in two of the three written tests.

Course Name

Code No.

VI. SPECIAL NOTES:

Special Needs:

If you are a student with special needs (e.g. physical limitations, visual impairments, hearing impairments, or learning disabilities), you are encouraged to discuss required accommodations with the instructor and/or contact the Special Needs office, Room E1204, Extension 493, 717, or 491 so that support services can be arranged for you.

Retention of course outlines:

It is the responsibility of the student to retain all course outlines for possible future use in acquiring advanced standing at other postsecondary institutions.

Disclaimer for meeting the needs of learners:

The Professor reserves the right to change the information contained in this course outline depending on the needs of the learner and the availability of resources.

Substitute course information is available in the Registrar's office.

VII. PRIOR LEARNING ASSESSMENT:

Students who wish to apply for advanced credit in the course should consult the instructor.